WASHINGTON HIGHER EDUCATION COORDINATING BOARD

Washington State Higher Education Coordinating Board
Resolution Number 06-11
2006-2007 High-Demand Enrollment Grant

Institution:

Central Washington University

Program:

Organic Chemistry

Budget Amount[1]:

$186,968

FTE:

18

Proposal History[2]:

The original proposal was dated 5-3-06.
The proposal's budget was updated by Higher Education Coordinating Board on 5-25-06.

Notes:

1. The budget amount reflects changes resulting from the review process.

2. The proposal text and budget posted here on the HECB Web site reflect all revisions and updates, but the proposal cover letter does not. It is the cover letter submitted with the original proposal.

CENTRAL WASHINGTON UNIVERSITY

May 3, 2006

Ms. Katie Youngers
Higher Education Coordinating Board
917 Lakeridge Way SW
Olympia WA 98504-3430

Dear Ms. Youngers:

I am pleased to present Central Washington University's proposal to provide access to academic fields in high demand by students and employers, pursuant to stipulations of the Request for Proposals issued by the HECB on April 6, 2006 and the direction of the 2006 supplemental operating budget, ESSB 6386.

Central Washington University (CWU) proposes to expand access for eighteen (18) full-time equivalent students in the bachelor of science degree programs that rely upon organic chemistry. The chemistry courses will be offered at CWU's main campus in Ellensburg, and at CWU's University Centers at Yakima Valley Community College and Wenatchee Valley College.

In order to expand access to this high-demand field, CWU requests a total of $269,211.00, including $25,660.00 in one-time costs for 18 FTE students to hire faculty and upgrade software critical to teaching organic chemistry in lectures and laboratories.

Should you have questions regarding this proposal, please contact Dr. Linda Beath, Associate Vice President for Undergraduate Studies at linda.beath@cwu.edu, and by telephone at 509.963.1403.

Sincerely,

Jerilyn McIntyre, President

Rich Corona, Vice President for Business & Financial Affairs

Office of the President
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CENTRAL WASHINGTON UNIVERSITY
High-demand FTE Proposal to
Increase Access to the Field of Organic Chemistry

OVERVIEW

CWU proposes to expand access to the field of chemistry by increasing organic chemistry course and laboratory sections. By increasing the opportunities for students to take these courses, CWU will also improve access to the bachelor of science degree in multiple science disciplines, which require completion of coursework in organic chemistry. CWU proposes to enhance access to the course sequences on its main campus in Ellensburg, and to provide the courses to students at its University Centers at Yakima Valley Community College (YVCC) and Wenatchee Valley College (WVC).

The addition of two tenure-track faculty members in chemistry and organic chemistry would allow the Department of Chemistry to provide an additional two lecture sections and five laboratory sections in the organic sequence. Increasing faculty also will enable the Department of Chemistry to expand organic chemistry prerequisites such as general chemistry and introductory chemistry by adding three lectures and several laboratory sections to the existing curriculum. In total this investment will enable the program to enroll an additional 18 FTE students (454 headcount) during the 2006-07 academic year.

Students who complete this program will have the background needed for numerous careers where employers are seeking qualified employees, including but not limited to the following:

- teaching chemistry in high school;
- developing a variety of new consumer products, from perfumes to drugs;
- conducting analyses for quality control and product development in the wine and micro-brewery industries;
- nursing and allied health professions;
- conducting research in the agriculture, biochemistry and biotechnology industries; and
- analysis and research associated with environmental consulting, medical laboratory testing, and cancer research.

Student demand for organic chemistry is high at CWU because organic chemistry is required by several science degree programs: biology, chemistry, nutrition and dietetics, pre-professional programs in health care, and in secondary teaching areas in biology and chemistry. Employer demand, too, is quite high for graduates with a strong background in chemistry. Graduates are needed in the medical and bio-technology research industries, in the wine industry, and as nurses and high school teachers.

PROGRAM DESCRIPTION

The CWU Department of Chemistry is a dynamic, energetic, and growing organization that gives students an outstanding education in the chemical sciences and provides them with unique educational opportunities.

Faculty are committed to teaching excellence, putting collaboration between students and faculty at the center of undergraduate education. The College of the Sciences (COTS) Undergraduate Research Grants Program allows students to propose and conduct a research project in conjunction with a faculty mentor. Students present their findings at the Symposium On University Research and Creative Expression (SOURCE) and is regional and national venue. CWU bridges students' academic interests with their residence hall living experience by inviting students who share an interest in chemistry or other natural sciences to live together in the same residence hall, through the living learning communities. Students participate in out-of-classroom enrichment activities that support their academic pursuits and develop personal and academic relationships with other students and faculty. Highly qualified faculty and well-trained staff deliver CWU's chemistry program. They come to CWU from diverse institutions, including the California Institute of Technology, Harvard, Washington State University, the University of Hawaii, and Arizona State University. Faculty have been published recently in *The Journal of Materials Chemistry*; *Chemistry: Foundations and Applications; Chemistry of Materials;* and *The Journal of Geophysical Research*.

The chemistry program is located in the Science Building, a state-of-the-art facility, which opened in 1998 on the Ellensburg Campus. Laboratories are equipped with the latest science instrumentation and technology, as well as multimedia interfacing with CWU's seven campuses and the World Wide Web.

Organic chemistry is an essential course sequence for students seeking degrees in chemistry, biochemistry, pre-professional health programs, pre-nursing, and secondary chemistry teaching. The Department of Chemistry teaches two levels of organic chemistry courses. The CHEM 111-113 series is required in certain programs of biological sciences, nutrition, and preparation for allied health science programs such as dental hygiene and nursing. CHEM 111 is an introductory chemistry prerequisite for CHEM 112, which focuses on organic chemistry.

The CHEM 361-363 series is required for all bachelor of science chemistry majors. The first two courses in the CHEM 360 series are required for all bachelor of arts chemistry majors, including the B.A. in Chemistry Teaching, and are recommended for most biological science degrees. Students preparing for pre-professional health science programs such as medicine, dentistry, optometry, pharmacy, and veterinary medicine are advised to take the entire sequence.

The limitations of the chemistry laboratory facilities effectively cap enrollment in the laboratory portions of these courses**.** The specialized nature of the chemistry involved in organic reactions and synthesis requires access to large volume hoods.[1] Only one laboratory space in the Science Building contains enough hoods to be suitable for organic chemistry. This space holds 20 students safely and comfortably. Thus, laboratory sections are limited to 20 students.

C**WU is unable to accommodate student demand for organic chemistry courses** on the Ellensburg campus or at CWU-Yakima and CWU-Wenatchee. Enrollment in organic chemistry courses has increased by more than 150 percent since 2001.

[1] A laboratory chemical hood is a partially enclosed workspace that is exhausted to the outside of the building. The hood captures and expels hazardous gases and vapors before they enter the breathing space of students and faculty.

Until a year ago, the Department of Chemistry worked closely with faculty at Yakima Valley Community College and Wenatchee Valley College to provide a distance-education offering of the upper-division organic courses. The courses enabled community college students to complete an Associate of Science degree prior to transfer, effecting smooth articulation between the community college and CWU. The interactive television (ITV) courses enabled time- and place-bound students to complete upper-division chemistry without compromising their commitments to jobs or to family. The program also served more under-represented students than would have been possible by providing the courses only on Ellensburg's main campus.

Unfortunately, CWU had to discontinue the community college offerings to serve the growing student demand at Ellensburg campus. Funding this proposal would enable CWU to re-establish this valuable course offering on campuses where need is high, at YVCC and WVC.

WORK PLAN FOR 2006-2007

CWU proposes to hire two faculty to support the 454 additional headcount generated by enrolling 18 more yearly FTE. The responsibilities of one faculty person will be to teach the organic chemistry classes via distance education to serve Wenatchee and Yakima Valley Community Colleges. The second will teach sections of general chemistry prerequisite courses.

Earlier this year the Department of Chemistry launched a national search for a full-time, non-tenure track position when it became clear that demand for chemistry was seriously overwhelming the teaching and advising capacity of the faculty. The department has the authority to search, but not to hire, until a fund source is identified.

CWU will immediately hire two full-time, *non-tenure-track* faculty for these positions from the results of the current search process. The process can be expanded to identify the two faculty needed to fill the position in fall 2006. During fall 2006, the Chemistry Department would begin the search for *full-time, tenure-track* faculty.

If the Higher Education Coordinating Board (HECB) approves funding for the expansion of this program on May 25, CWU proposes to enroll an additional 18 FTE through the following steps:

Summer 2006

- Hire two full-time non-tenure track lecturers in chemistry with expertise in organic and general chemistry.
- Work with YVCC and WVC to provide organic chemistry through ITV.
- Begin a search for computer and laboratory support staff.
- Schedule additional organic chemistry sections.

Fall 2006

- Hire computer and laboratory support staff.
- Increase organic lecture and laboratory offerings above 2005-06 levels.
- Increase general and introductory chemistry prerequisite offerings above 2005-06 levels.

- Offer organic chemistry via distance education to YVCC and WVC.
- Purchase upgrade to *Spartan* software.[2]
- Begin search process to hire tenure-track faculty.

Winter 2007

- Increase organic lecture and laboratory offerings above 2005-06 levels.
- Offer organic chemistry via distance education to YVCC and WVC.
- Increase general and introductory chemistry prerequisite offerings above the 2005-06 levels.

Spring 2007

- Increase organic laboratory offerings above 2005-06 levels.
- Increase introductory chemistry prerequisite offerings above 2005-06 levels.
- Offer organic chemistry via distance education to YVCC and WVC.

Table 1 shows the new FTE and headcount numbers CWU proposes to serve in the 2006-07 academic year augmenting those in the current year. The table includes headcount and FTE for both organic sequences and prerequisite courses in which enrollments are currently limited.

Table 1. PROPOSED HEADCOUNT AND FTE IN ORGANIC CHEMISTRY AY 2006-07 Compared to AY 2005-06

	FALL			WINTER			SPRING		
Academic Year	Course	Head-count	FTE	Course	Head-count	FTE	Course	Head-count	FTE
2005-06	361	138	9.2	362	126	8.4	361Lab	19	0.8
	361Lab	71	3.2	361Lab	21	0.9	363	71	4.7
	181	212	18.8	112	59	5.2	363Lab	40	1.8
	111	108	9.6	112Lab	53	1.2			
Total 05-06		501	40.8		147	15.7		130	7.3
2006-2007	361	155	10.3	361Lab	80	3.6	363	75	5.0
	361Lab	80	3.6	362	150	10.0	363DE	8	0.5
	361DE	8	0.5	362DE	8	0.5	363Lab	60	2.7
	181	220	19.6	112	65	5.8	111	70	6.2
	111	120	10.7	112Lab	60	1.3	111Lab	70	1.6
Total 06-07		583	44.7		363	21.2		286	16.2
ADDITIONAL HC / FTE		82	3.9		216	5.5		156	8.9

[2] *Spartan* is a molecular modeling/computational chemistry program that provides students with theoretical techniques for the description of molecular structure and energy, investigation of chemical reactions, and elucidation of product distributions.

RESPONSIVENESS TO ECONOMIC NEEDS

Chemistry is a key element in a wide array of jobs including industrial biotechnology, drug design, materials science, chemical biology, and teaching. The need for more graduates in these fields is noted by the Higher Education Coordination Boards' *State and Regional Needs Assessment*; in the technology priorities named in house Bill 2817; in the Office of the Superintendent of Public Instruction report on teaching shortage areas; and in the U.S. Department of Education's list of teaching shortage areas.

✓**Higher Education Coordination Boards'** ***State and Regional Needs Assessment.*** According to the HECB's research, many of the industries identified as the focus of statewide economic development activities are those that require a strong background in the chemical sciences. The report notes that education programs, such as chemistry, which are required for positions within high-demand industries, often are in short supply.

✓ **House Bill 2817** was approved by the Legislature in 2006 to establish science and technology as priority program areas for postsecondary education. Among the priorities, the legislation names two areas that require postsecondary education in chemistry: biotechnology and science.

✓ **The Office of the Superintendent of Public Instruction** names chemistry among the teaching areas in which schools are unable to find qualified teachers. The report notes 51 vacancies in chemistry for the 2003-04 school year. This proposal provides students who seek a B.A. in Chemistry Teaching greater opportunity to take the organic chemistry courses they need to graduate in a timely way and become employed in this teaching shortage area.

✓ **U.S. Dept. of Education** lists chemistry as a teaching shortage area in Washington state for the 2001-02, 2002-03, and 2003-04 school years. The Code of Federal Regulations (CFR)[3] enables Federal Perkins Loan borrowers who are full-time teachers of science to qualify for cancellation of up to 100 percent of their loan.

RESPONSIVENESS TO DESIRABLE ATTRIBUTES

Enhancing Higher Education Access For Under-Represented Students.

Expanding access to the organic chemistry course sequence at Ellensburg, Yakima, and Wenatchee would enhance access to higher education by students historically under-represented in college participation.

More than 17 percent of CWU undergraduate students are people of color, one of the highest percentages of any public university in the state. As of fall 2004, the most recent year for which data is now available, CWU had the highest percentage of Hispanic students of any Washington public university.

[3] 34 CFR 674.53(c).

Students of color represent about 54 percent of enrollment at Yakima Valley Community College[4] (YVCC) and 36.4 percent at Wenatchee Valley College[5] (WVC). In academic year 2004-05 YVCC reported 4,165 Latino/Hispanic students out of a total student headcount of 11,033. During the same period, WVC served 1,488 Latino/Hispanic students out of a total student population of 7,599 (headcount).

Increasing Upper-Division Access In Regions With Low Participation Rates.[6]

Providing greater access to the organic course sequences at Ellensburg and at CWU-Yakima and CWU-Wenatchee would help the state achieve the goal of increased participation in higher education in regions with significantly lower-than-average rates of participation. The HECB's *State and Regional Needs Assessment* analyzes higher education needs throughout the state. It names the Tri-County region (Kittitas, Yakima, and Klickitat Counties) and the North Central region (Chelan, Douglas, Grant, and Okanogan counties) as those in which participation in higher education occurs at a much lower rate than the state average. According to HECB research, the Tri-County region would need to increase current enrollment by 30 percent to match the state's average participation rate.[7]

According to the HECB report, in the Tri-County region 7,833 students are currently enrolled in college, 54 percent of whom attend a four-year institution. Of these approximately 34 percent attend CWU.[8] Based upon HECB projections, the Tri-County region will gain about 16,647 people in the next seven years. Upper-division enrollments are projected to increase from 1,775 FTE in 2003-2004 to 1,854 FTE in 2010-11. Increasing the regional participation rate to match the state average would generate an additional 272 enrollments, bringing the 2010 enrollment total to 2,126 FTE.

The story is similar in the North Central Region. For 17-24 year olds, participation in higher education in the region is below the state average. As the region grows over the next decade the HECB predicts upper-division enrollment capacity will have to increase by 13 percent between 2003-04 and 2010-11 based on population increases. If participation rates remain the same, enrollments will expand from 1,605 FTE to 1,842 FTE in 2010-11.

CWU is the primary higher education institution providing upper-division access to the Tri-County and North Central regions. CWU is well positioned to provide efficient, high quality access to upper-division education to people in this high-need area. Giving people additional access to multiple degree options that are highly employable very likely will boost regional participation rates.

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[4] State Board for Community and Technical Colleges, *Washington Community and Technical Colleges Academic Year Report*, 2004-2005.
[5] Ibid.
[6] "Participation rate" refers to the percentage of the population in a certain age group, such as 17-22 year olds, enrolled in college.
[7] Higher Education Coordinating Board, *State and Regional Needs Assessment*, Feb. 2006, p. 35.
[8] Ibid.

Partnerships To Improve Articulation And Transfer For Two-Year College Students.

CWU, YVCC, and WVC have been partners since the 1980s, when Central established CWU-Yakima on the YVCC campus and CWU-Wenatchee, at Wenatchee Valley College, respectively. CWU's well-established partnerships with YVCC and WVC allow students to earn a two-year degree from the community college, and then simply transfer into upper-division CWU courses without leaving the community college campus. Transfer opportunities, however, are limited by CWU's fiscal capacity to provide programming at Yakima and Wenatchee. The Legislature does not provide funding for University Centers. CWU funds programs at those campuses out of general state funding provided for all programs.

It is highly likely that more students would transfer into a baccalaureate program if more opportunities were available. In Yakima the organic chemistry course sequence would complement the YVCC Nursing program, which offers a six-quarter Associate Degree in Nursing, and Washington State University's Intercollegiate College of Nursing on the YVCC campus. The organic sequence also would allow students to complete an Associate of Science degree program and transfer seamlessly to CWU into science programs not currently offered through the CWU-Yakima program.

Letters of endorsement from Dean Alexander Roberts (WVC) and Dean Mary Lou Rozdilsky (YVCC) show strong support and need for organic chemistry classes at the community colleges. Please see Appendix A for these and other letters of endorsement.

DEMONSTRATION OF STUDENT DEMAND

Enrollment in organic chemistry courses has increased by more than 150 percent since 2001. Student demand for enrollment in organic chemistry courses has exceeded the Department of Chemistry's capacity. In the 2005-06 academic year, extraordinary student demand forced the department to make the difficult decision to close some organic and general education courses, simply to serve students in other high-demand chemistry courses.

Table 2 shows the increases in enrollment in organic chemistry courses. In 2004-2005, the last year that all existing student needs were accommodated, enrollment had increased by 150 percent over the prior three years.

Table 2. GROWTH IN ORGANIC CHEMISTRY ENROLLMENT

	2001-02	2002-03	2003-04	2004-05	2005-06*
CHEM 361	94	125	115	140	138
CHEM 361Lab	88	125	110	127	111
CHEM 362	71	126	107	142	126
CHEM 363	39	68	46	76	71
CHEM 363Lab	29	58	38	59	40

**The reduced laboratory offerings also reduced the lecture population to some extent since these are typically taken together.*

Wait-lists and Student Need Data: Out of a concern for students and knowing that course offerings would not meet student demand, the department collected data during the 2005-

06 academic year to document student need for organic chemistry. One measure of student need was the wait-lists generated during registration. In fall 2005 six student were wait-listed for CHEM 361and 15 for CHEM 361Lab. In winter 2006 13 students were wait-listed in 361Lab; four were wait-listed in spring 2006 for 363 Lab. These data underestimate the actual need because some students determined that their chances of getting in the class were too slim to bother with the wait-list.

A second measure of need came from forms the students were invited to fill out if their course needs were not being met. Twelve students filled out forms, seven of which expressed that organic chemistry was a particular cause for their concern. Three of these students noted that their inability to get a required lab section would delay their graduation. Others expressed concern that they would have to take an overload in an upcoming quarter. Some also were concerned about the number of labs they would need to schedule in one quarter and the real potential for overlap in the times they are offered. One student said, "Now I am forced to wait until next year and I have no guarantee that I will even get in then. Even if I do get into the laboratory there is at least one, if not two, other labs that I must be enrolled in simultaneously."

Student demand for organic chemistry is high at CWU also because organic chemistry is a "gatekeeper" course, required by several academic programs: biology, chemistry, nutrition and dietetics, pre-professional programs in health care, and in secondary teaching areas in biology and chemistry. Without the capacity to meet demand for organic chemistry, CWU's ability to efficiently graduate secondary science teachers, health care professionals, and scientists is compromised.

DEMONSTRATION OF EMPLOYER DEMAND

The outlook for employment is strong across a range of industries for both experienced and newly graduated chemists, according *Chemical & Engineering News.*[9] The companies that are seeking chemists include those from the chemical, high-tech, aerospace, consulting, medical research, petroleum, and biotech industries — all vibrant and growing industries within Washington state.

The greater access to organic chemistry provided through this proposal prepares graduates to join several high-growth sectors of the economy in which employers seek qualified job applicants.

- **Employment in the biotech and medical device industry** tripled between 1990 and 2002, when the combined industry employed 19,360 people. Employees of biotechnology and medical device companies are well paid, earning an average of $64,000 in 2001, nearly double the statewide average of $37,000.

- **The marine services industry** employs chemists as architects and marine engineers; in aquaculture; and in sectors including worldwide container transportation, shipyards repairs, and building and designs (military & civilian). Chemists work in the development of advanced materials for the industry, including a broad spectrum of high tech-materials such as composites and plastics.

[9] Susan J. Ainsworth, "Opportunities For B.S. and M.S. Chemists," *Chemical & Engineering News*, January 2, 2006, Volume 84, Number 01, pp. 35-38.

- **Biomedical research** requires the expertise of chemists to conduct research into the nature, causes, prevention and eradication of disease. In 2003, the state established a $350 million Life Sciences Discovery Fund to fund biomedical research in the state, with some projecting that intensified research funding could create 20,000 jobs over the next 10 to 15 years and 100 companies. Since 1990, employment in biotechnology and medical devices grew at an average annual rate of 10 percent, and found that the industry employed 19,300 people in 2002; indirect employment was about 43,000 statewide.[10]

- **Chemists in the biotechnology forest products industry** create disease- and insect-repellent trees. They improve the efficiency with which trees convert solar energy into increased growth; increase cellulose content for paper making activities, create enzymes for pulping and pine pitch removal, and use wood product wastes for energy products and manufacturing high-value organic compounds. The forest products sector provided an estimated 29,100 jobs, while the pulp and paper sectors employed an estimated 14,600 Washingtonians in 2002. Forest products manufacturing is projected to grow at about 1 percent per year through 2012.

- **The value-added agriculture/food processing industry** uses biotechnology to enhance agriculture productivity. Chemists create new ways to increase crop yield and decrease crop inputs. They develop environmentally compatible pest control methods, crossbreeding, and hybridization. Chemists use biotechnology to improve food additives that increase nutritional value while retarding spoilage.

- **Bio-fuel development is an emergent industry** whose promising future earned a boost from the state Legislature in 2006. The passage of Senate Bill 6508[11] likely will increase the demand for people with the chemistry background required for the development and production of bio-fuels such as bio-diesel, bio-gas, and ethanol products.

- **More than 400 wineries and 30,000 acres of wine grapes are helping feed the demand for chemists.** The $2.4 billion Washington wine industry, which thrives in the Tri-County region, supports more than 11,000 related jobs. Most wineries hire enologists, who have a strong chemical background in the science of wine, working closely with the winemaker to determine the types of yeasts, fermentation practices, use of chemical additives and preservatives all throughout the process. The largest wineries also hire their own laboratory and chemistry staff.

Employment Security's "Workforce Explorer" database provides a picture of some of the many job openings for chemists in the state:

[10] Huckell/Weinman Associates, Inc., *The Biotechnology and Medical Device Industry in Washington State:* An Economic Analysis, http://www.wabio.com/econ_dev_reports/WA_EconomicImpactStudySummary2002.pdf , December 2002.

[11] The bill mandates fuel dealers to sell 2 percent bio-diesel out of their total diesel sales and 2 percent ethanol out of total gasoline sales. It also complements a similar federal law called the Renewable Fuels Standard (RFS) that mandates the US reach 7.5 billion gallons of bio-fuel use by 2012.

Washington State Job Openings Chemistry-related Positions 2003	
Career areas	No. Openings
Engineers (e.g. chemical, biomedical, petroleum)	24
Biological scientists (e.g. environmental, microbiologists, biochemists, epidemiologists)	120
Chemists	43
Dietitians and Nutritionists	28
Physical scientists (e.g. materials scientists, hydrologists,)	66
Technicians & Technologists (e.g. agricultural and food science, chemical, medical and clinical lab)	219
TOTAL	490

Job growth is expected to be strong for positions requiring a background in chemistry. Openings are forecast to grow by 10 to 13 percent through 2012 for the following professions: physicists, life scientists, and technicians in the life, geological, and physical sciences. Employment Security predicts job openings in Washington will grow by 15 to 20 percent in these career areas: geoscientists (17.9 percent), hydrologists (15.7 percent), health technologists and technicians (19.4 percent); microbiologists (14.6) percent; medical scientists (15.8 percent); physical scientists (17 percent); and zoologists and wildlife biologists (15.0 percent).

Evidence that employers will seek students served by enhanced access to organic chemistry is found in attached letters of support from several Washington employers.

Pacific Northwest National Laboratory (PNNL) in Richland, Washington, employs over 4,000 people, including a significant number of scientists and technicians who must possess high levels of competence in organic chemistry. Dr. S. Thevuthasan is a staff scientist at PNNL's William R. Wiley Environmental Molecular Sciences Laboratory (EMSL). He has written in support of expanding access to the organic chemistry course sequence in order to better prepare CWU science program graduates to perform state-of-the-art multidisciplinary research in the fields of chemistry, physics, biology, environmental science, and material science. According to Dr. Thevuthasan, "The support of CWU's educational efforts by the Washington HEC Board high demand funding initiative will increase the level of competence of students in Washington state thereby making them more competitive job-seekers to PNNL."

Pace International, LLC, a privately owned agricultural chemical company headquartered in Seattle, also supports CWU providing greater access to the field of organic chemistry. Dr. Edmund Huang, Vice President for Manufacturing, Development & Labs, says organic and biochemistry are the foundation of the business, which develops technologies to enhance, protect and preserve fruit and vegetable quality. According to Dr. Huang, "Education is the foundation of industry. Pace and other industrial companies need the support from

government and universities to continuously supply highly-skilled professionals to raise our technology standard and to compete in the global market place."

Since 2001, more than 84 schools and businesses have hired CWU graduates with chemistry backgrounds. These include employers in Illinois, New Jersey, Colorado, Virginia, and Texas, as well as a diverse array of Pacific Northwest employers, such as the Alaska Fisheries Science Center, Cell Therapeutics, Inc., the Washington State Dept. of Agriculture, Hogue Cellars winery, Honeywell, and Unigen Pharmaceuticals.

IDENTIFICATION OF PROGRAM GOALS, OUTCOMES, AND ASSESSMENT PLAN

The goals of the organic series reflect the chemistry department program goals. Students completing any of the four undergraduate chemistry major programs will:

- Know the standard technical information and be able to perform experimental techniques of general, organic, analytical and physical chemistry.
- Be able to speak and write clearly in the language and style of the discipline.
- Demonstrate quantitative problem-solving skills. This includes having a firm foundation in the fundamentals and applications of mathematics, physics and statistics as it applies to experimental design and data analysis.
- Be able to use computers and discipline specific software.
- Be able to retrieve and critically analyze chemical literature.
- Be aware of current health and safety protocols that are an integral part of the discipline.
- Be able to work effectively in group situations.

CWU assesses program goals through a capstone course in which students complete a portfolio. Graduating seniors take an exit survey on their perceptions of the program. The outcomes for the courses are shown in Table 3 with their corresponding assessment protocols. At the end of the organic sequence students must take the American Chemical Society's standardized exam, which allows CWU to compare its students to a nationally normed sample.

Table 3. OUTCOMES AND ASSESSMENTS FOR ORGANIC CHEMISTRY COURSES

COURSE	STUDENT OUTCOMES	ASSESSMENTS
CHEM 361	▪ Practice problem solving, both independently and as a team member. ▪ Apply an understanding of organic chemistry to both the natural and "synthetic" worlds. ▪ Interpret the symbolism and begin to understand the language of organic chemistry, including the IUPAC system for naming organic molecules. ▪ Recognize typical organic functional groups. ▪ Use infrared (IR) and nuclear magnetic resonance spectroscopy for organic structure determination. ▪ Apply the chemical principles learned in general chemistry to the properties and reactivity of organic molecules.	Exams Quizzes Exercises
CHEM 361Lab	▪ Acquire first-hand knowledge of the chemical and physical properties of several classes of organic compounds.	Lab Notebooks Lab Reports

	▪ Use important techniques for isolation and purification of organic compounds, including recrystallization, extraction, and distillation. ▪ Use several methods for organic analysis, including melting point determination, thin layer chromatography, and infrared and nuclear magnetic resonance spectroscopy. ▪ Practice the scientific method by formulating hypotheses, planning experiments to test hypotheses, troubleshooting procedures, and drawing conclusions from data and observation.	Formal Lab Report Exam
CHEM 362	▪ Practice problem solving, independently and as a team member. ▪ Apply an understanding of organic chemistry to both the natural and "synthetic" worlds. ▪ Use the language and symbols of organic chemistry to communicate and interpret organic chemical structures, chemical reactivity and synthetic logic and transformations. ▪ Apply the chemical principles learned in general chemistry and in CHEM 361 to the properties and reactivity of organic molecules.	Exams Quizzes Spectroscopy Exercise
CHEM 363	▪ Interpret the symbolism and use the language of organic chemistry, including the IUPAC system for naming organic molecules. ▪ Apply general chemical principles to bonding and reactivity of organic molecules. ▪ Recognize the relationship between structure and physical properties. ▪ Recognize typical organic functional group transformation, particularly reactions involving carboxylic acid derivatives, enols and enolates, polyenes, aromatic compounds, amines, and carbohydrates. ▪ Recognize the importance of resonance and aromaticity. ▪ Recognize and determine reaction mechanisms and intermediate structures. ▪ Practice problem-solving and further develop reasoning by analogy skills.	Exams ACS Exam
CHEM 363Lab	▪ Appropriately use several important techniques for isolation and purification of organic compounds, including recrystallization, extraction, distillation, and chromotography. ▪ Select and use a variety of chemistry laboratory and computational techniques which are appropriate toward achieving the desired synthetic organic outcomes. ▪ Carry out advanced functional group transformations. ▪ Practice formulating hypotheses, planning experiments to test hypotheses, troubleshooting procedures, and drawing conclusions from obtained data and observations. ▪ Generate scientific reports targeted for specific readers, written clearly, and produced in exquisite form. ▪ Practice scientific public presentation skills and use peer review as a method of refinement.	Lab Reports

Specific Strategies To Assess and Report Graduation or Completion Rates

In addition to the program and course assessment described above, program success will be determined by retention rates from general chemistry into organic chemistry and throughout the organic sequence. Students taking organic chemistry will be tracked to determine graduation rates. Employment data for graduates from chemistry, biology, and nutrition and dietetics programs will be tracked, as well as, participation in graduate and professional degree programs.

BUDGET

- **Tenure-Track Faculty Positions ($130,000: salary and benefits):** The two faculty positions in the first year will be filled by non-tenure track faculty. The addition of a faculty member in organic chemistry will allow the department to add two lectures and five laboratory sections to the organic sequence. Adding a second faculty member to provide greater access to prerequisite courses to organic chemistry would allow a greater number of students into the programs supported by organic chemistry. These additional faculty resources also will increase opportunities for undergraduate research.

- **Computer Support Staff ($35,100: salary and benefits):** The addition of a half-time computer and laboratory support specialist would provide the department faculty with support in the operation and maintenance of networked computers, computer peripherals, software, and instrumentation.

The department has 171 computers including 16 high-end Silicon Graphics workstations used exclusively by the organic chemistry program. Twenty-five of the computers are interfaced with instrumentation critical to the organic course sequences and organic research. The department houses 65 peripherals such as printers and scanners. In addition, the organic chemists use 12 different discipline-specific software programs to deliver their curriculum. Thirty-two software programs are used in the department that are not supported through the university's ITS (Information Technology Services) department.

- **Goods and Services ($10,040):** An increase in the annual base budget for Goods and Services funded to the Department of Chemistry would cover the cost of two additional faculty and the associated increases in materials and supplies needed for additional lectures and laboratories added as a result of this program.

- **Equipment ($5,000):** This funding will allow for on-going upkeep and upgrades for software.

- **Other ($18,000** in one-time funds**):** CWU seeks one-time funding to upgrade two specific pieces of software critical to the pedagogical approach in organic lectures and laboratories. One, *PC Spartan*, is used to perform computations and molecular modeling, a key visual for a discipline that is abstract by nature. This is an expensive, but important, software license that is impossible to purchase within existing funding structures. The other software package, *SYBYL*, allows sophisticated molecular modeling providing students and faculty with the fundamental components for understanding molecular structure and properties.

PLAN TO CONTINUE PROGRAM BEYOND THE 2006-07 FISCAL YEAR

The additional FTE generated in 2006-07 through funding of the organic "bottleneck" proposal is a significant step in meeting student and employer needs in many high demand areas. With continual funding for two faculty positions, support staff, and goods and services costs, the chemistry department and the College of the Sciences are making an on-going commitment to serve the university's mission. This funding also allows the department the ability to continue to provide high quality instruction and undergraduate research opportunities for which it is known.

The support provided through this proposal will allow students at CWU - Yakima and CWU - Wenatchee to achieve their career goals in the chemical and biological sciences, chemistry teaching, and health careers. Funding will allow all students to access the courses critical to their success in a timely and efficient manner.

Appendix A

Letters of Endorsement

WENATCHEE VALLEY COLLEGE
INSTRUCTION OFFICE

May 1, 2006

Dr. Linda S. Beath, Associate Vice President
Central Washington University
400 East University Way
Ellensburg, WA 98926-7503

Dear Dr. Beath:

Wenatchee Valley College is pleased to endorse Central Washington University's request for funding from the Higher Education Coordinating Board by enhancing access to the organic chemistry program in Ellensburg, Yakima Valley Community College, and Wenatchee Valley College.

Wenatchee Valley College has longstanding commitments to the allied health fields but we have been limited in our ability to offer organic chemistry because of facility limitations. Your request for funding is welcome because we cannot add organic chemistry capacity fast enough to meet general science and engineering needs. New statewide efforts to ramp up mathematics and sciences education, as well as coordinated transfer pathways for two-year college graduates to pursue baccalaureate degrees, will result in greater student demand for organic chemistry.

It is clear that expanding the organic chemistry program at Central Washington University will play a vital role in preparing students for future employment. Wenatchee Valley College transfers more students to Central Washington University than any other public baccalaureate institution so this effort at capacity building compliments the mission of Wenatchee Valley College.

Thank you for the opportunity to support your funding request and please let me know if there is anything we can do to assist you further in this effort.

Sincerely,

Alex L. Roberts, Dean
Liberal Arts & Sciences

P: 509.682.6600 | F: 509.682.6601 | 1300 Fifth Street | Wenatchee, WA 98801 | www.wvc.edu

Yakima Valley Community College
South Sixteenth Avenue & Nob Hill Boulevard P.O. Box 22520 Yakima, WA 98907-2520
Yakima Campus
Phone: (509) 574-4600
Fax: (509) 574-6860
Web: www.yvcc.edu

May 1, 2006

Dr. Linda Beath
Associate Vice President for Undergraduate Studies
Central Washington University

Dear Dr. Beath:

On behalf of our college, I would like to strongly support Central Washington University's request for funding to increase Community College student access to Central's Organic Chemistry program.

This class is very important for our students preparing to be Science majors: those who plan to major in Biology, Environmental Science, Chemistry, pre-Med, pre-Dent, Pharmacy etc. Students in our new Viticulture and Enology programs will also need Organic Chemistry in order to transfer to four-year programs. As preparation in the major becomes a more significant consideration in admission to baccalaureate institutions in our state, reliable access to Organic Chemistry will become even more consequential to students.

In 2007 our college will be opening a new state-of-the-art building housing all our science labs. We are anticipating stronger Science enrollments as more students realize the advantage of preparing for science and engineering majors locally before transfer. As we build our science enrollments, support from a collaborative agreement to provide access to Organic Chemistry will be even more important in serving our students.

YVCC supports efforts to strengthen University –Community College partnerships and Centers to increase access and outreach. This proposal has our unequivocal support!

Sincerely,

Mary Lou Rozdilsky
Dean, Arts and Sciences

Grandview Campus Learning Center
500 West Main First
Grandview, WA 98930-1264
WA 98948-1564

Ellensburg Learning Center
401 Mountain View
Ellensburg, WA 98926

Sunnyside Learning Center
2201 Edison, #2
Sunnyside, WA 98944

Toppenish
516 West
Toppenish,

Appendix B

Letters of Support

Pace International

April 27, 2006

Dr. Linda Beath
Central Washington University
400 E. University Way MS 7503
Ellensburg, WA 98926

Dear Dr. Beath,

I am a vice president of Pace International Company. I write this letter in support of expanding the Organic Chemistry program at Central Washington University.

Pace International, LLC is a privately owned agricultural chemical company with its headquarter in Seattle, WA. The company employs approximately 100 people world-wide and 55 people in Washington State. The company's business is dedicated to "use innovative solutions that enhance, protect and preserve fruit and vegetable quality". The fruit /vegetable industry that we work in brings over two billion dollars revenue to the state economy. Pace has devoted significant resources and efforts in research and development. Pace is the innovator that brings new technologies, such as thermo-fogging of DPA and fungicides, and new products, such as apple sunburn-protection, cherry anti-splitting and organic potato anti-sprouting products, to the market. Organic and bio-chemistry are the basis of our research and development work, and indeed, Pace R&D facility at Wapato, WA employs eleven (11) chemists and technicians, including three (3) PhD, two (2) master and two (2) bachelor scientists. These high quality researchers help Pace maintain and grow our business.

Education is the foundation of industry. Pace and other industrial companies need the support from government and universities to continuously supply highly-skilled professionals to raise our technology standard and to compete in the global market place. The Organic Chemistry program at Central Washington University and the outreach program to Yakima Valley Community College and Wenatchee Valley College will expand student class offering and accessibility. These well nurtured and trained students are the future of our industry and we enthusiastically support such a program.

Sincerely yours,

Edmund T. Huang

Edmund T. Huang, PhD
VP of Manufacturing, Development & Labs
Pace International, LLC

Pace International, LLC
tel 800.722.2476
fax 509.848.2506
5661 Branch Road
Wapato, WA 98951
www.paceint.com

Kelly Scientific
RESOURCES

April 28, 2006

Dr. Linda Beath
Central Washington University
400 E. University Way MS 7503
Ellensburg, WA 98926

Dear Dr. Beath:

This letter is written on behalf of the Seattle branch of Kelly Scientific Resources, in support of the expansion of the Organic Chemistry Department at Central Washington University.

Our parent company, Kelly Services, is an international, Fortune 500 company with a reputation for excellence and, for the past ten years, Kelly Scientific Resources has been the global leader in scientific staffing. We service companies in the United States, Europe and the Pacific Rim by assisting them with their staffing needs. We work with companies from a variety of different industries including biotechnology, pharmaceutics, environmental and manufacturing.

In the Seattle area, it has been our experience that chemists are in high demand; specifically, analytical chemists, organic chemists, physical chemists and wet chemists. In fact, many of our positions draw upon skills learned in various chemical specialties. In 2005, we placed a minimum of 25 chemists throughout the Seattle area. Of those chemists, at least 10 use organic chemistry technique in their day-to-day work activities. It has also been our experience that positions which require a high-level of organic chemistry knowledge are often the most difficult to fill. In fact, it is not uncommon for companies to hire senior level analytical chemists and train them in organic technique because of the shortage of senior level organic chemists.

It is our hope that the expansion of Central Washington University's Organic Chemistry Program will instill the next generation of scientists with a passion for the field of organic chemistry, a field that is sadly lacking in quality, skilled talent. We are excited about the possibilities this development might bring to us and to our clients. Therefore, we earnestly support this expansion.

Sincerely,

Jessica Nims
Scientific Recruiter

3625 132nd Ave. SE, Ste. 410 • Bellevue, WA 98006 • 425-562-0451

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

May 1, 2006

Dr. Linda Beath
Associate Vice President
Undergraduate Studies
Central Washington University

Dear Dr. Beath:

Central Washington University (CWU) has asked me to write a letter of support expressing the importance of organic chemistry training for students and for future employees at Pacific Northwest National Laboratory (PNNL) in Richland. I understand that CWU is in the process of requesting high demand funding from the Higher Education Coordinating Board to enhance access to courses on their main campus in Ellensburg and to expand the organic chemistry program to some of its university centers. As a staff member at PNNL, I understand the need for technical experts in chemistry/organic chemistry area, particularly at PNNL, and the importance associated with the educational efforts of our regional universities to train these experts. I strongly support CWU's efforts and recommend that the high demand funding should be approved so that CWU can enhance access to courses in their main campus and to expand the program to some of its university centers.

I am a Staff Scientist and a Technical Group Leader at the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), a U.S. Department of Energy (DOE) national scientific user facility located at PNNL which provides integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences to support the needs of DOE and the nation. PNNL employs over 4,000 staff and has a business volume of about $725 million. The state-of-the-art multidisciplinary research done here spans the fields of chemistry, physics, biology, environmental science and material science. In order to accomplish our mission, we require that our employees receive the best training possible in their fields. All chemists and biologists must master organic chemistry in order to receive their degrees and many projects in other fields of research which EMSL and PNNL engage in (such as material science in the direction of nanomaterials synthesis and charcaterization) require expertise in organic chemistry as well. The support of CWU's educational efforts by the Washington HEC Board high demand funding initiative will increase the level of competence of

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Telephone (509) 376-1375■ Email theva@pnl.gov ■ Fax (509) 376-5106

students in Washington state thereby making them more competitive job-seekers to PNNL. Since PNNL is an employer of a significant number of scientists and technicians it would be a pleasure to see an increased level of competence in organic chemistry within our own state. To this end, I strongly support CWU's request for these high demand funds.

If you need additional information, please feel free to contact me at (509) 376-1375.

Sincerely,

S. Thevuthasan
Staff Scientist, TL
Interfacial & Nanoscale Science Facility
Environmental Molecular Sciences Laboratory

Appendix C

Budget

Program: Chemistry 2006-07 HIGH DEMAND ENROLLMENTS

	Student Headcount (Optional)	Student FTE (Required)
New Students Served by this proposal	60.0	18.0

	Staff Headcount	Staff FTE	One Time Costs	Recurring Costs	Total Costs
	Optional	Required	All Sources	All Sources	All Sources
Faculty Salaries (including benefits)					
Faculty including benefits		2.0		130,000	130,000
Adjuncts including benefits					0
TA Salaries including benefits					0
Staff Salaries (including benefits)					
Exempt					0
Classified				35,100	35,100
Hourly					0
Personal Service Contracts - describe					
Goods and Services				10,040	10,040
Travel					
Equipment				5,000	5,000
Other - describe if over $5000			18,000		18,000
Total Instruction	0.0	2.0	18,000	180,140	198,140
Academic Affairs (Primary Support)				15,851	15,851
Libraries					0
Students Services				6,605	6,605
Institutional Support				22,456	22,456
Plant O&M				18,493	18,493
Indirect Costs (Grant Administration)					
Total Expenditures (Uses)	**0.0**	**2.0**	$18,000	$243,545	$261,545
Total Cost Per Student FTE					14,530
Less: Annual Tuition Per Student					4,143
Requested State Funding Per Student FTE					10,387

Notes:

1. **Other: Two software programs used by the organic faculty and students including "Spartan" at $15,000 and an upgrade to a currently existing program "SYBYL" at $3,000.**
2. **Budget updated 5-25-06 to remove $7,666 one time grant administration cost, to modify formatting, and to add notes 2 and 3.**
3. **Annual Tuition Per Student is computed as follows: $4,143 is the amount of resident undergraduate tuition recorded in fund 149 Institutions of Higher Education – Operating Fees Account.**